Implementing IP Addressing Services

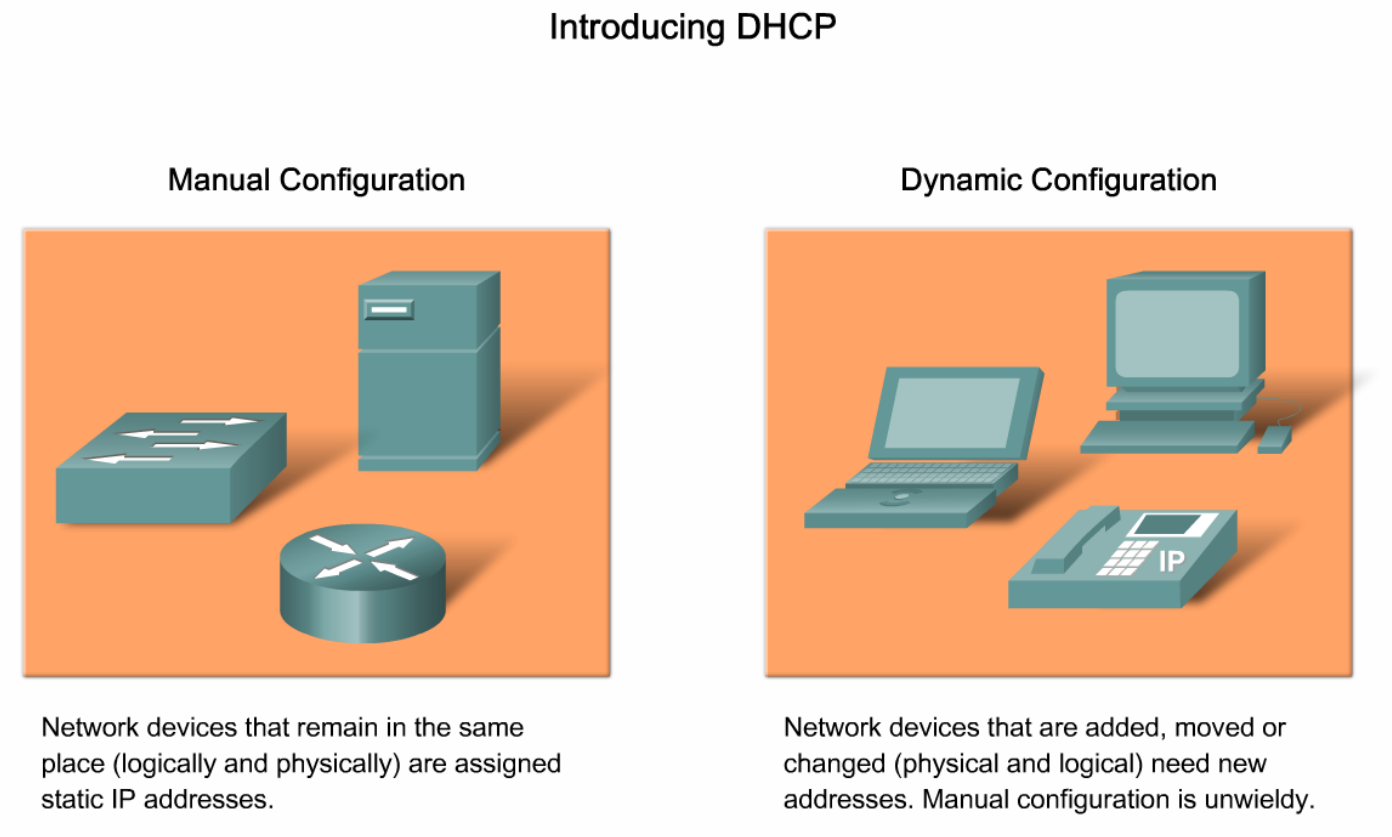
Accessing the WAN – Chapter 7

Objectives

- Configure DHCP in an enterprise branch network
- Configure NAT on a Cisco router
- Configure new generation RIP (RIPng) to use IPv6

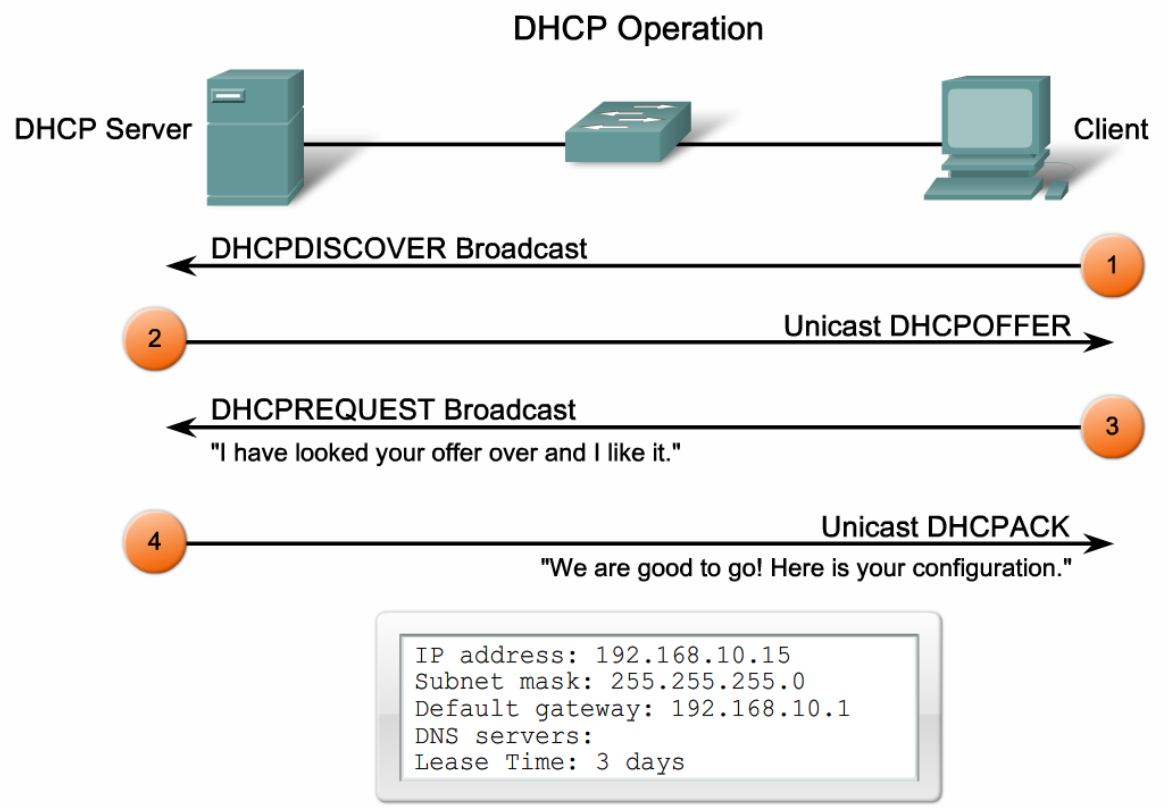
Configure DHCP in an Enterprise Branch Network

- Describe the function of DHCP in a network



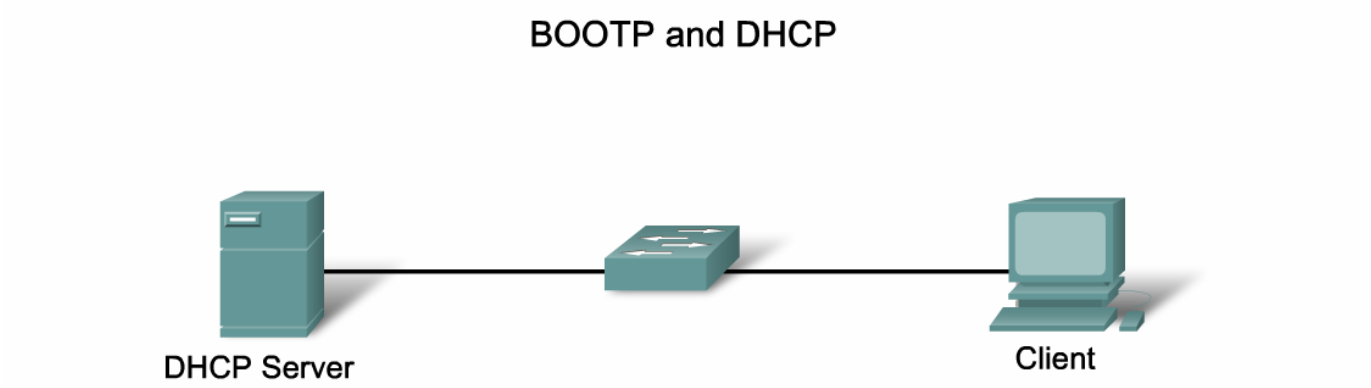
Configure DHCP in an Enterprise Branch Network

- Describe how DHCP dynamically assigns an IP address to a client



Configure DHCP in an Enterprise Branch Network

- Describe the differences between BOOTP and DHCP



BOOTP	DHCP
Static mappings	Dynamic mappings
Permanent assignment	Lease
Only supports four configuration parameters	Supports over 20 configuration parameters

Configure DHCP in an Enterprise Branch Network

- Describe how to configure a DHCP server

Configuring DHCP Step 1: Excluding IP Addresses

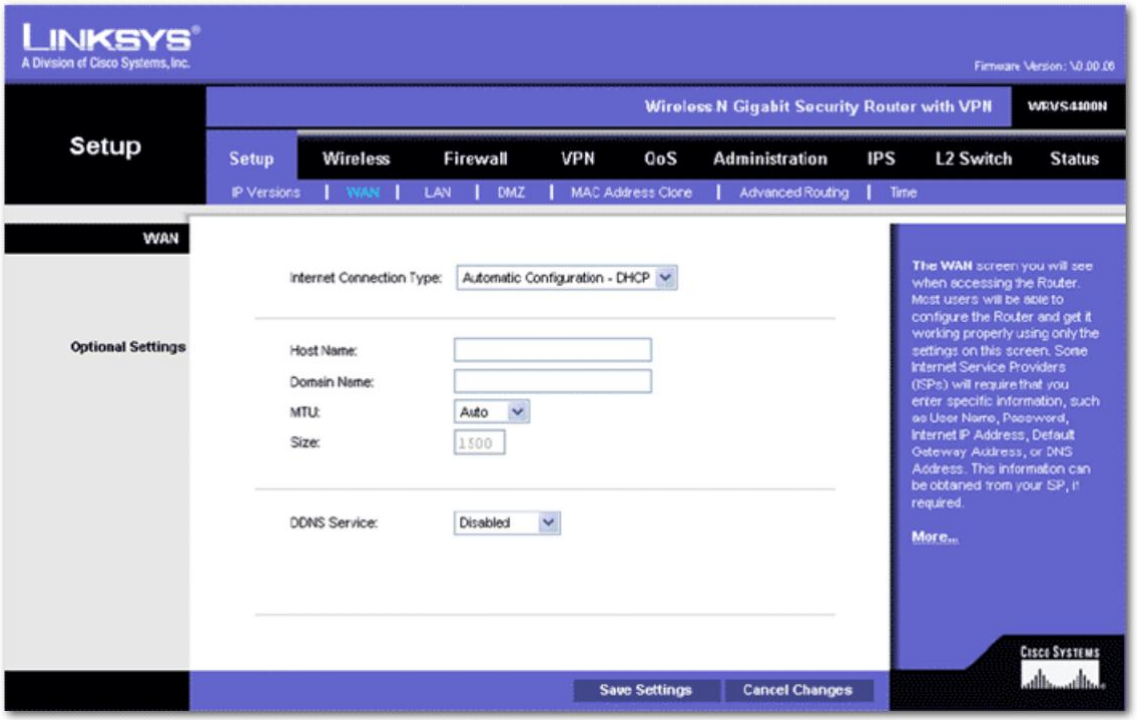
```
R1(config)#ip dhcp excluded-address low-address [high-address]
```

```
R1(config)#ip dhcp excluded-address 192.168.10.1 192.168.10.9
R1(config)#ip dhcp excluded-address 192.168.10.254
```

Configure DHCP in an Enterprise Branch Network

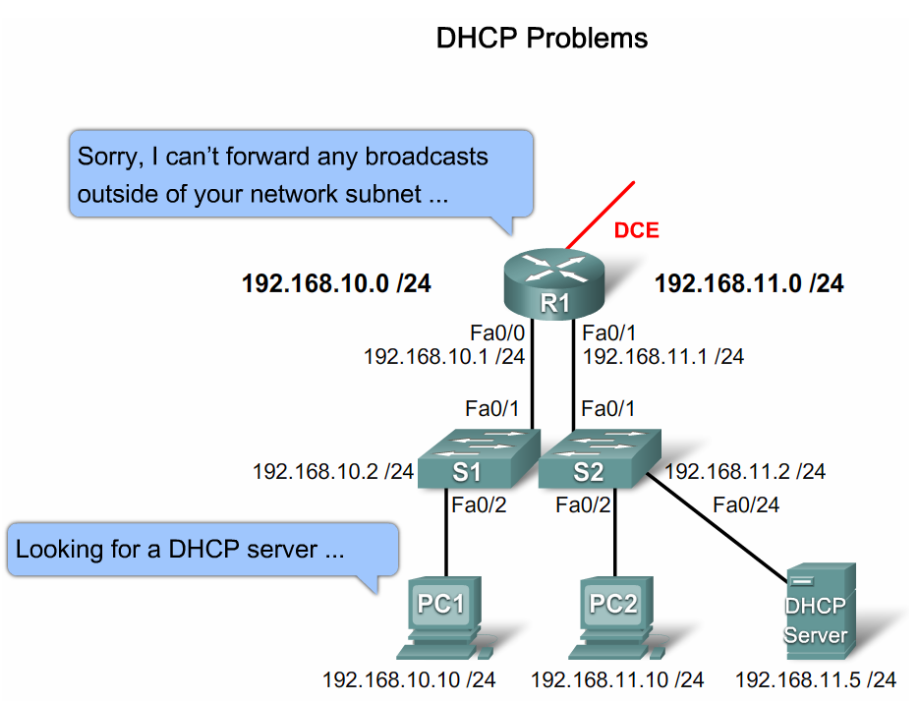
- Describe how to configure a Cisco router as a DHCP client

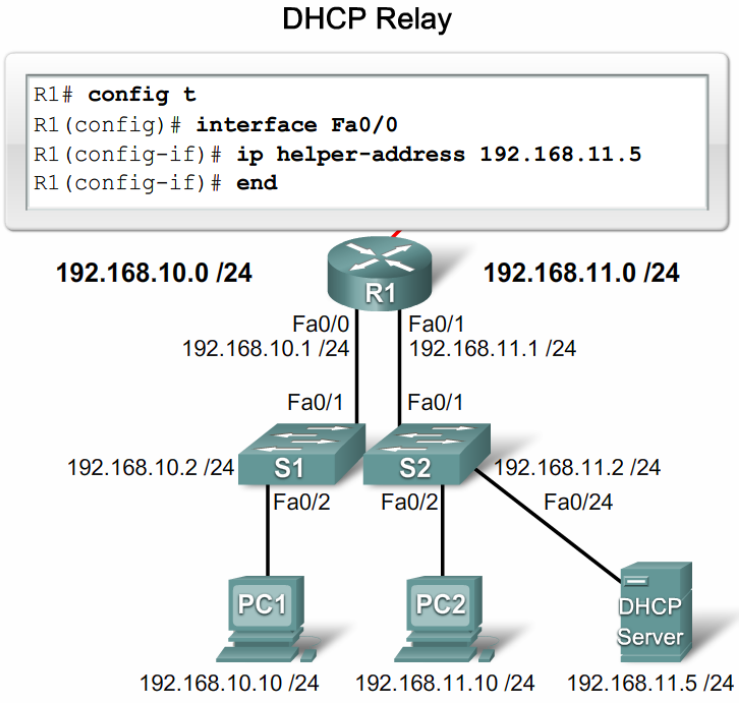
Linksys WAN Connection



Configure DHCP in an Enterprise Branch Network

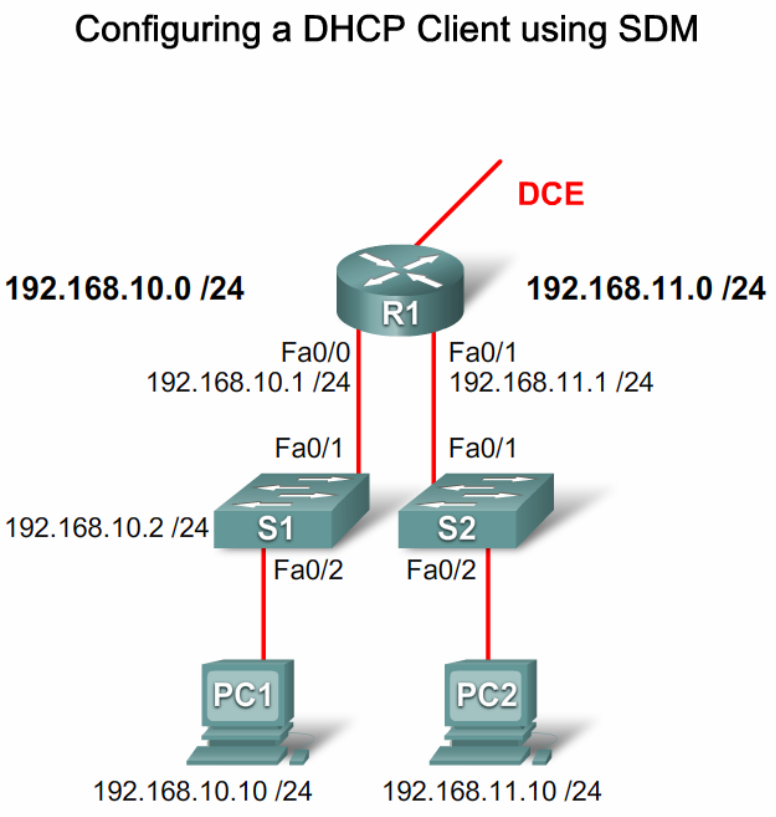
- Explain how DHCP Relay can be used to configure a router to relay DHCP messages when the server and the client are not on the same segment





Configure DHCP in an Enterprise Branch Network

- Describe how to configure a Cisco router as a DHCP client using SDM



Configure DHCP in an Enterprise Branch Network

- Describe how to troubleshoot a DHCP configuration

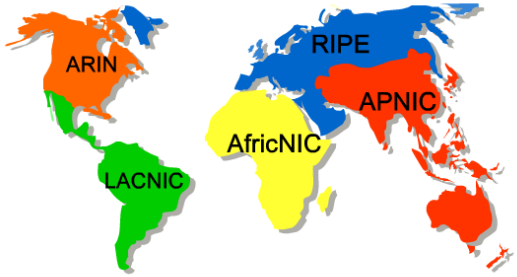
Troubleshooting DHCP Configurations

Troubleshooting DHCP	
Troubleshooting Task 1:	Resolving IP Address Conflicts
Troubleshooting Task 2:	Verify Physical Connectivity
Troubleshooting Task 3:	Test Network Connectivity by Configuring Client Workstation with a Static IP Address
Troubleshooting Task 4:	Verify Switch Port Configuration (STP Portfast and Other Commands)
Troubleshooting Task 5:	Distinguishing whether DHCP Clients Obtain IP Address on the Same Subnet or VLAN as DHCP Server

Configure NAT on a Cisco Router

- Describe the operation and benefits of using private and public IP addressing

Public and Private Internet Addresses



Public Internet addresses are regulated by five Regional Internet Registries (RIRs):

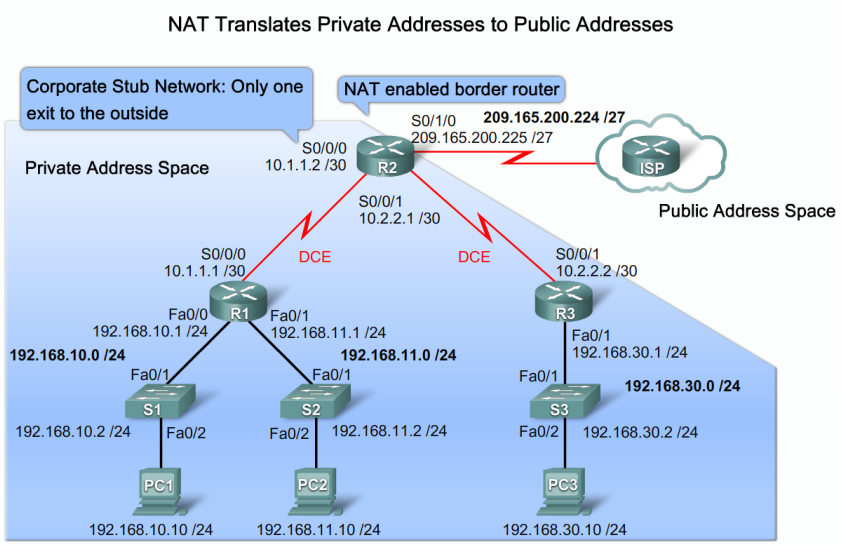
- ARIN
- RIPE
- APNIC
- LACNIC
- AfriNIC

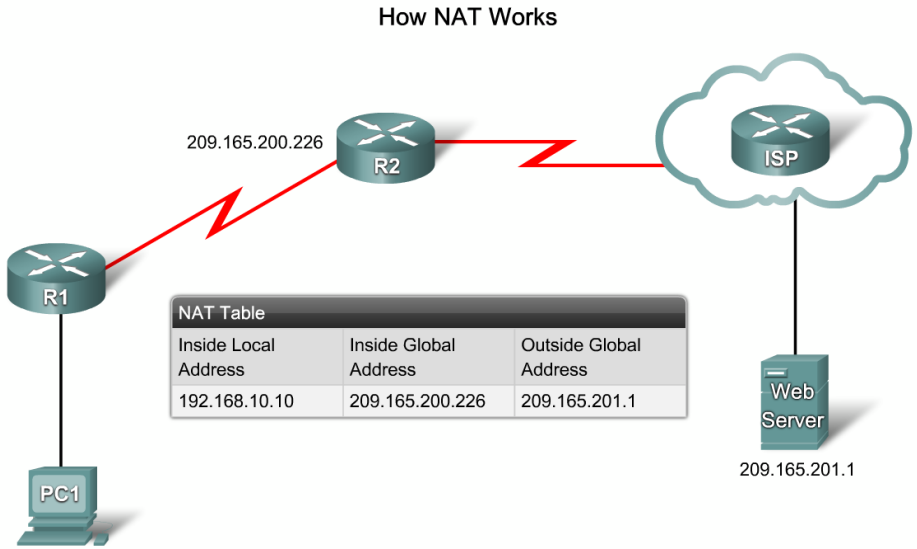
Private Internet addresses are defined in RFC 1918:

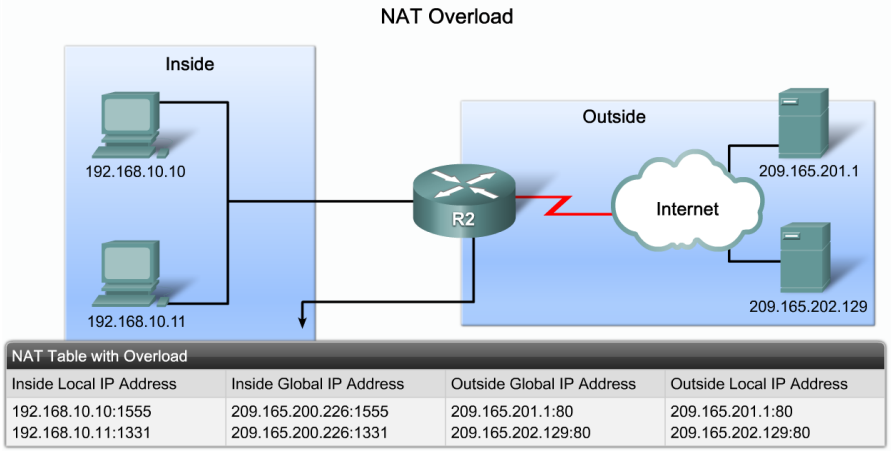
Class	RFC 1918 Internal Address Range	CIDR Prefix
A	10.0.0.0 - 10.255.255.255	10.0.0.0/8
B	172.16.0.0 - 172.31.255.255	172.16.0.0/12
C	192.168.0.0 - 192.168.255.255	192.168.0.0/16

Configure NAT on a Cisco Router

- Explain the key features of NAT and NAT overload







Configure NAT on a Cisco Router

- Explain the advantages and disadvantages of NAT

NAT Benefits and Drawbacks

NAT Benefits

- Conserves the legally registered addressing scheme
- Increases the flexibility of connections to the public network
- Provides consistency for internal network addressing schemes.
- Provides network security

NAT Drawbacks

- Performance is degraded
- End-to-end functionality is degraded
- End-to-end IP traceability is lost
- Tunneling is more complicated
- Initiating TCP connections can be disrupted
- Architectures need to be rebuilt to accommodate changes

Configure NAT on a Cisco Router

- Describe how to configure static NAT to conserve IP address space in a network

Configuring Static NAT

Step	Action	Notes
1	Establish static translation between an inside local address and an inside global address. `Router(config)#ip nat inside source static local-ip global-ip`	Enter the global command **`no ip nat inside source static`** to remove the static source translation.
2	Specify the inside interface. `Router(config)#interface type number`	Enter the **`interface`** command. The CLI prompt will change from `(config)#` to `(config-if)#`.
3	Mark the interface as connected to the inside. `Router(config-if)#ip nat inside`	
4	Exit interface configuration mode. `Router(config-if)# exit`	
5	Specify the outside interface. `Router(config)#interface type number`	
6	Mark the interface as connected to the outside. `Router(config-if)#ip nat outside`	

Configure NAT on a Cisco Router

- Describe how to configure dynamic NAT to conserve IP address space in a network

Configuring Dynamic NAT

Step	Action	Notes
1	Define a pool of global addresses to be allocated as needed. `Router(config)#ip nat pool name start-ip end-ip {netmask netmask|prefix-length prefix-length}`	Enter the global command **no ip nat pool** *name* to remove the pool of global addresses.
2	Define a standard access list permitting those addresses that are to be translated. `Router(config)#access-list access-list-number permit source [source-wildcard]`	Enter the global command **no access-list** *access-list-number* to remove the access list.
3	Establish dynamic source translation, specifying the access list defined in the prior step. `Router(config)#ip nat inside source list access-list-number pool name`	Enter the global command **no ip nat inside source** to remove the dynamic source translation.
4	Specify the inside interface. `Router(config)#interface type number`	Enter the **interface** command. The CLI prompt will change from `(config)#` to `(config-if)#`.
5	Mark the interface as connected to the inside. `Router(config-if)#ip nat inside`	
6	Specify the outside interface. `Router(config)#interface type number`	
7	Mark the interface as connected to the outside. `Router(config-if)#ip nat outside`	
8	Exit interface configuration mode. `Router(config-if)# exit`	

Configure NAT on a Cisco Router

- Describe how to configure NAT Overload to conserve IP address space in a network

NAT Overload Configuration Example

Step	Action	Notes
1	Define a standard access list permitting those addresses that are to be translated. `Router(config)#access-list acl-number permit source [source-wildcard]`	Enter the global command `no access-list access-list-number` to remove the access list.
2	Establish dynamic source translation, specifying the access list defined in the prior step. `Router(config)#ip nat inside source list acl-number interface interface overload`	Enter the global command `no ip nat inside source` to remove the dynamic source translation. The overload keyword enables PAT.

3	Specify the inside interface.
	`Router(config)#interface type number`
	`Router(config-if)#ip nat inside`
		Enter the `interface` command. The CLI prompt will change from `(config)#` to `(config-if)#`.

4	Specify the outside interface.
	`Router(config-if)#interface type number`
	`Router(config-if)#ip nat outside`	

NAT Overload Configuration Using a Pool of Public Addresses

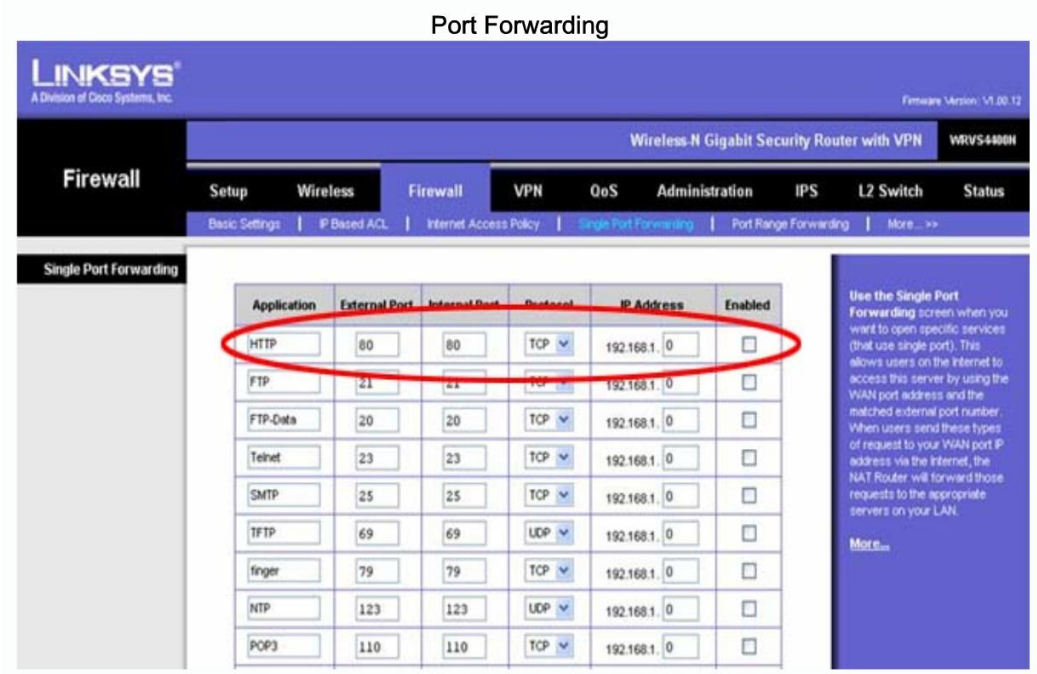
Step	Action	Notes
1	Define a standard access list permitting those addresses that are to be translated. `Router(config)#access-list acl-number permit source [source-wildcard]`	Enter the global command `no access-list access-list-number` to remove the access list.
2	Specify the global address, as a pool, to be used for overloading. `Router(config)#ip nat pool name start-ip end-ip {netmask netmask | prefix-length prefix-length}.`	
3	Establish overload translation. `Router {config}#ip nat inside source list acl-number pool name overload.`	

4	Specify the inside interface.
	`Router(config)#interface type number`
	`Router(config-if)#ip nat inside`
		Enter the `interface` command. The CLI prompt will change from `(config)#` to `(config-if)#`.

5	Specify the outside interface.
	`Router(config-if)#interface type number`
	`Router(config-if)#ip nat outside`	

Configure NAT on a Cisco Router

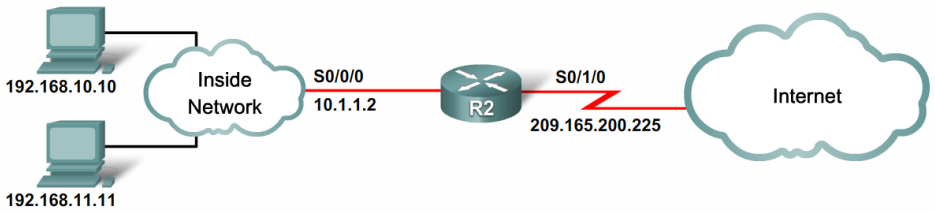
- Describe how to configure port forwarding



Configure NAT on a Cisco Router

- Describe how to verify and troubleshoot NAT and NAT overload configurations

NAT Overload Configuration Example




```
access-list 1 permit 192.168.0.0 0.0.255.255
ip nat inside source list 1 interface serial 0/1/0 overload
interface serial 0/0/0
  ip nat inside
interface serial 0/1/0
  ip nat outside
```

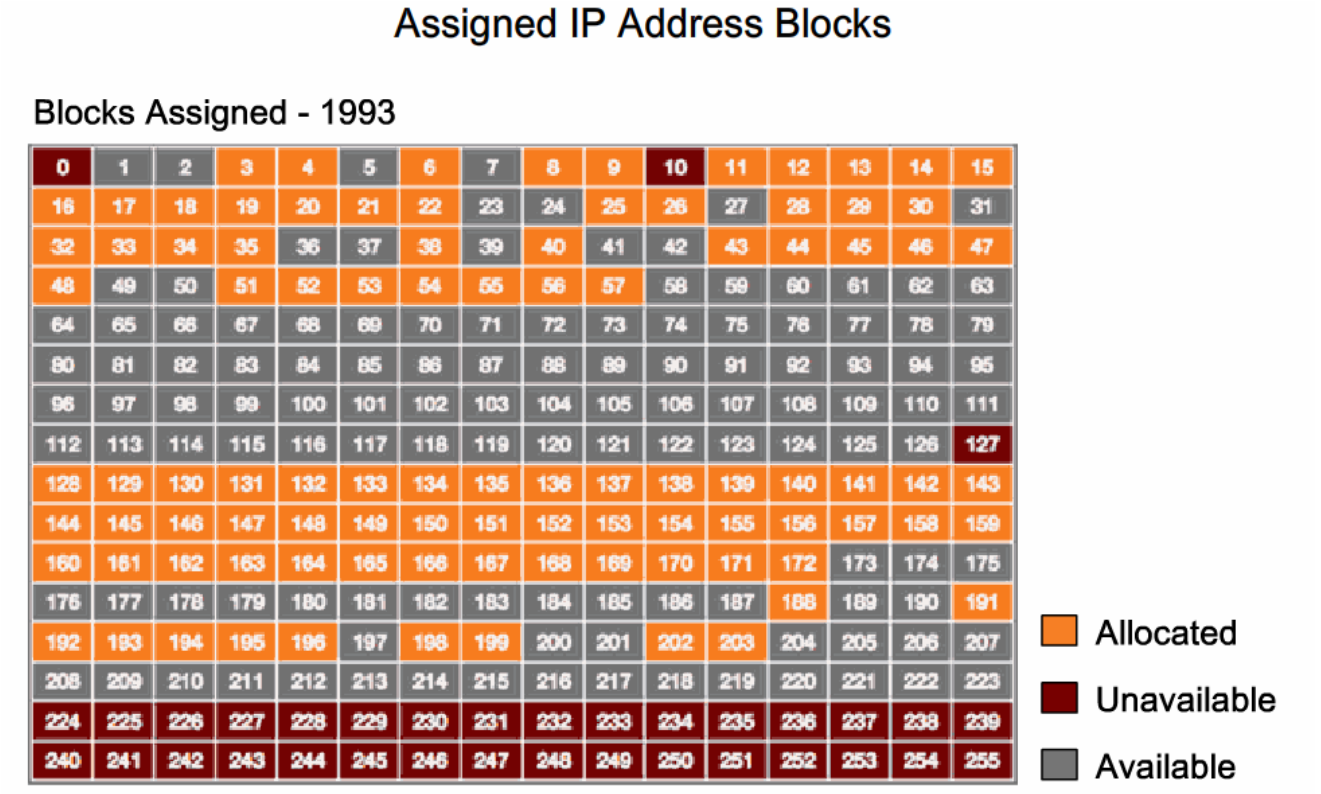
Debug NAT Translations

```
R2# debug ip nat
IP NAT debugging is on
R2#
*Oct  6 19:55:31.579: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14434]
*Oct  6 19:55:31.595: NAT*: s=209.165.200.254, d=209.165.200.225->192.168.10.10 [6334]
*Oct  6 19:55:31.611: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14435]
*Oct  6 19:55:31.619: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14436]
*Oct  6 19:55:31.627: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14437]
*Oct  6 19:55:31.631: NAT*: s=209.165.200.254, d=209.165.200.225->192.168.10.10 [6335]
*Oct  6 19:55:31.643: NAT*: s=209.165.200.254, d=209.165.200.225->192.168.10.10 [6336]
*Oct  6 19:55:31.647: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14438]
*Oct  6 19:55:31.651: NAT*: s=209.165.200.254, d=209.165.200.225->192.168.10.10 [6337]
*Oct  6 19:55:31.655: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14439]
*Oct  6 19:55:31.659: NAT*: s=209.165.200.254, d=209.165.200.225->192.168.10.10 [6338]

<Output omitted>
```

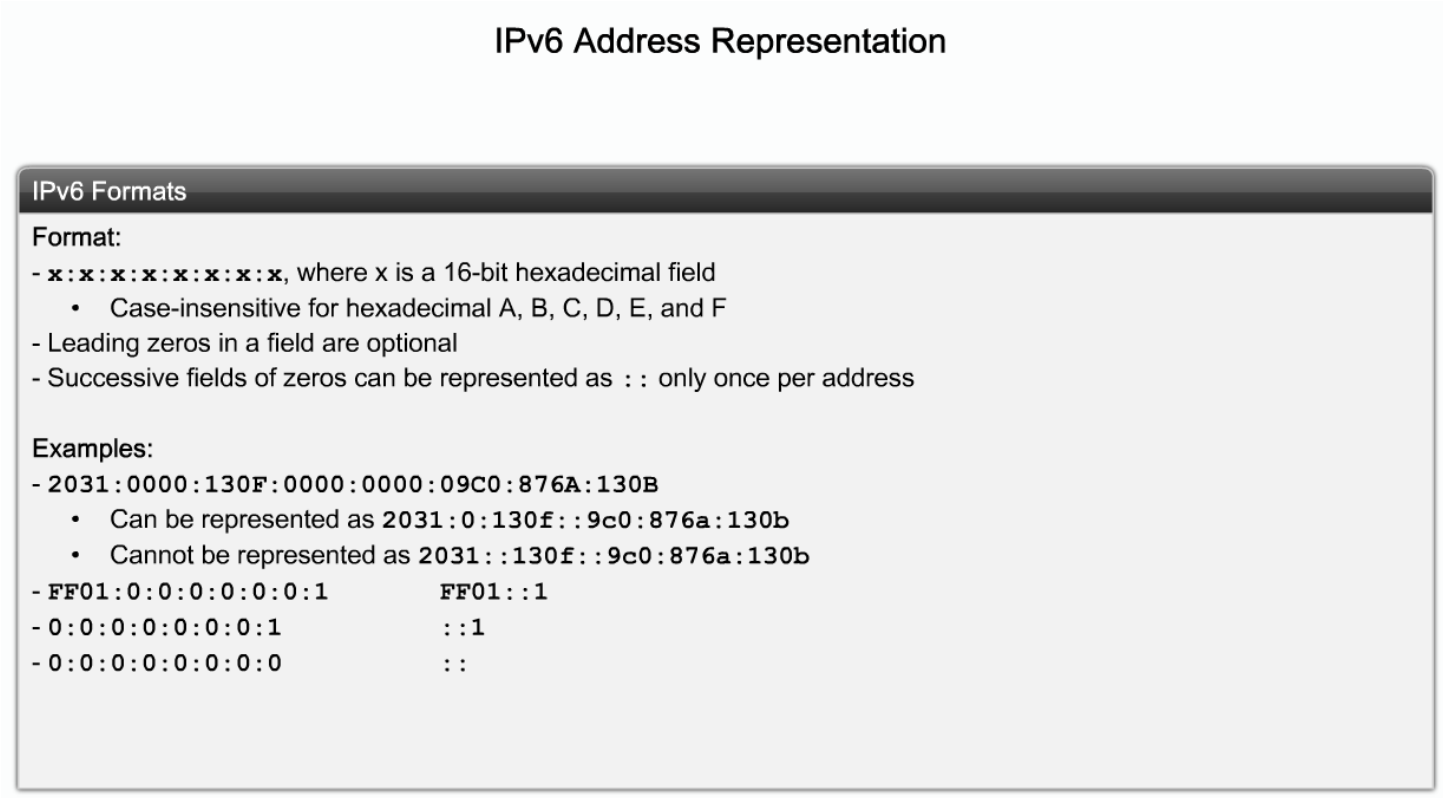
Configure New Generation RIP (RIPng) to use IPv6

- Explain the need for IPv6 to provide a long-term solution to the depletion problem of IP address



Configure New Generation RIP (RIPng) to use IPv6

- Describe the format of the IPv6 addresses and the appropriate methods for abbreviating them



Configure New Generation RIP (RIPng) to use IPv6

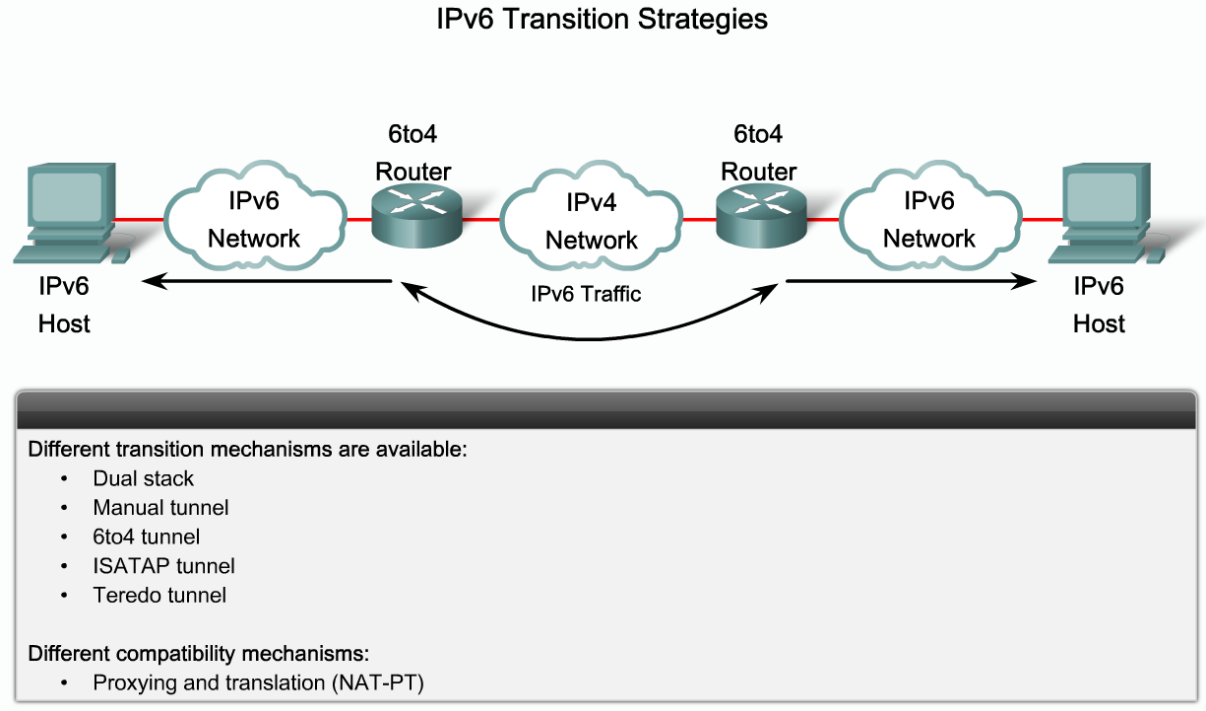
- Explain the various methods of assigning IPv6 addresses to a device

Assigning IPv6 Addresses

Static assignment	Dynamic assignment
• Manual interface ID assignment • EUI-64 interface ID assignment	• Stateless autoconfiguration • DHCPv6 (stateful)

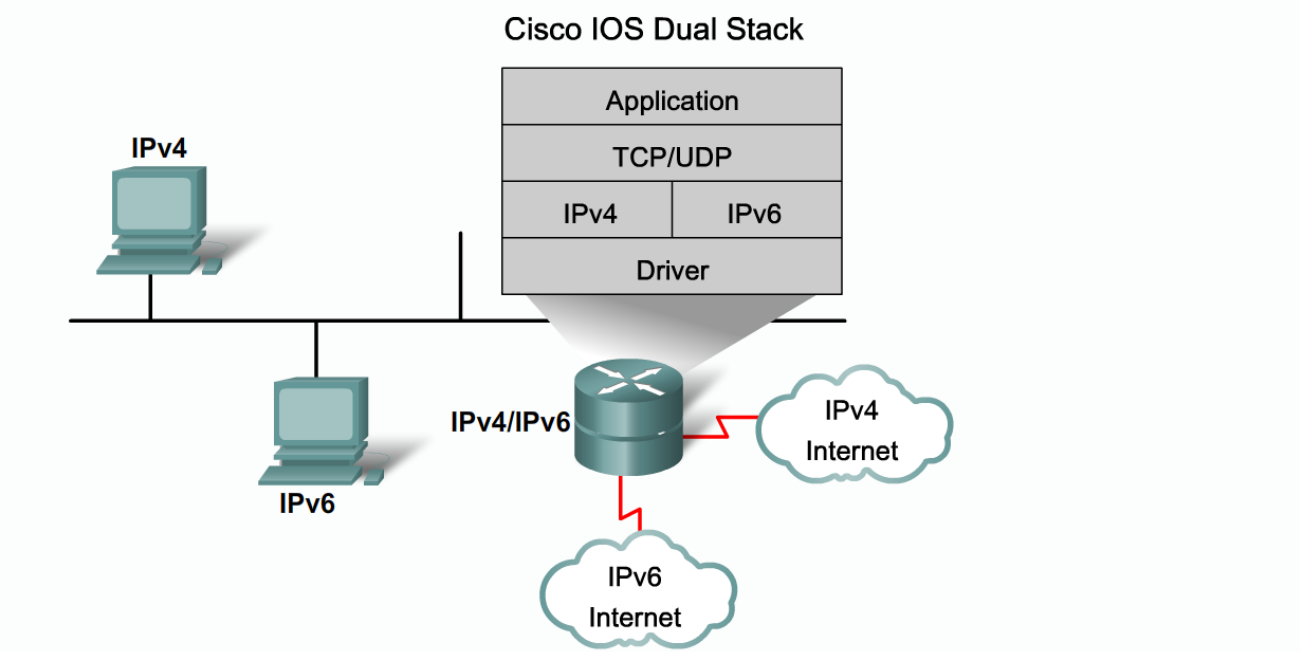
Configure New Generation RIP (RIPng) to use IPv6

- Describe the transition strategies for implementing IPv6



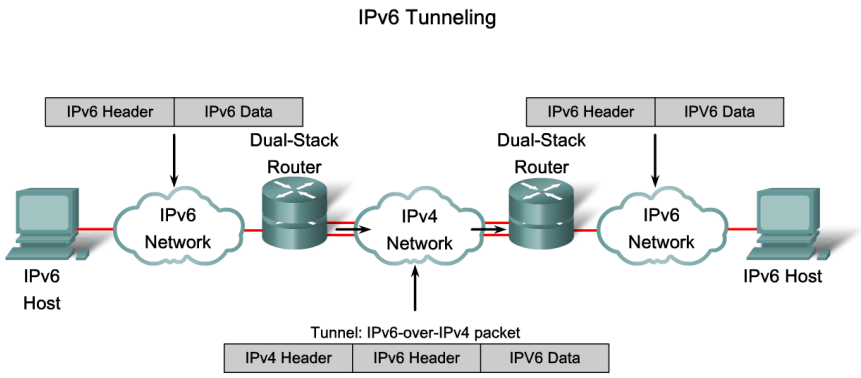
Configure New Generation RIP (RIPng) to use IPv6

- Describe how Cisco IOS dual stack enables IPv6 to run concurrently with IPv4 in a network



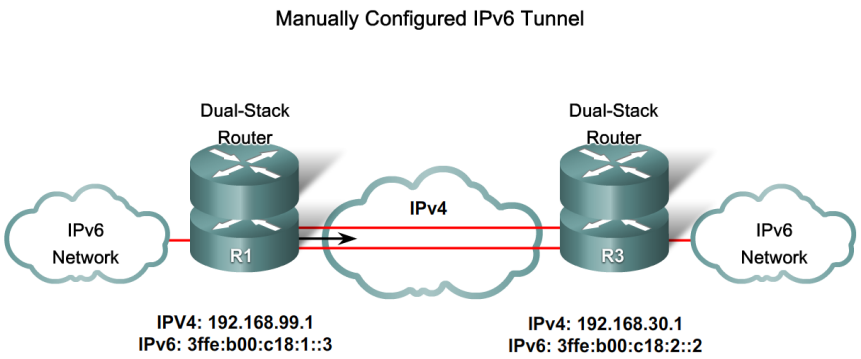
Configure New Generation RIP (RIPng) to use IPv6

- Describe the concept of IPv6 tunneling



Tunneling is an integration method in which an IPv6 packet is encapsulated within another protocol, such as IPv4. This method of encapsulation is IPv4:

- Includes a 20-byte IPv4 header with no options and an IPv6 header and payload
- Requires dual-stack routers



Configured tunnels require:

- Dual-stack endpoints
- IPv4 and IPv6 addresses configured at each end

Configure New Generation RIP (RIPng) to use IPv6

- Describe how IPv6 affects common routing protocols, and how these protocols are modified to support IPv6

RIPng Routing Protocol

Similar IPv4 features:

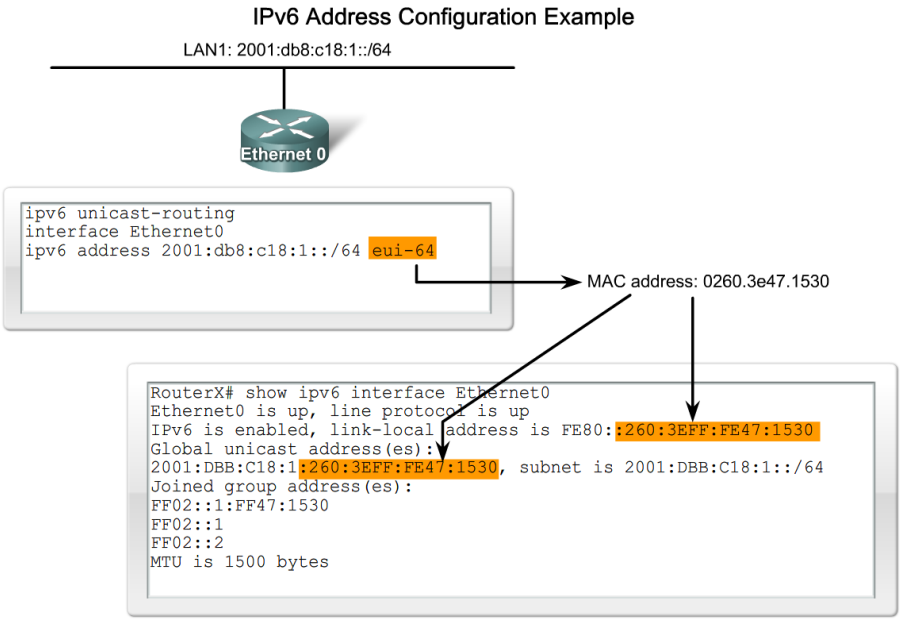
- Distance vector, radius of 15 hops, split horizon, and poison reverse
- Based on RIPv2

Updated features for IPv6:

- IPv6 prefix, next-hop IPv6 address
- Uses the multicast group FF02::9, the all-rip-routers multicast group, as the destination address for RIP updates
- Uses IPv6 for transport
- Named RIPng

Configure New Generation RIP (RIPng) to use IPv6

- Explain how to configure a router to use IPv6



Enabling IPv6 on Cisco Routers

Command	Purpose
`RouterX(config)# ipv6 unicast-routing`	Enables IPv6 traffic forwarding
`RouterX(config-if)# ipv6 address ipv6prefix/prefix-length eui-64`	Configures the interface IPv6 addresses

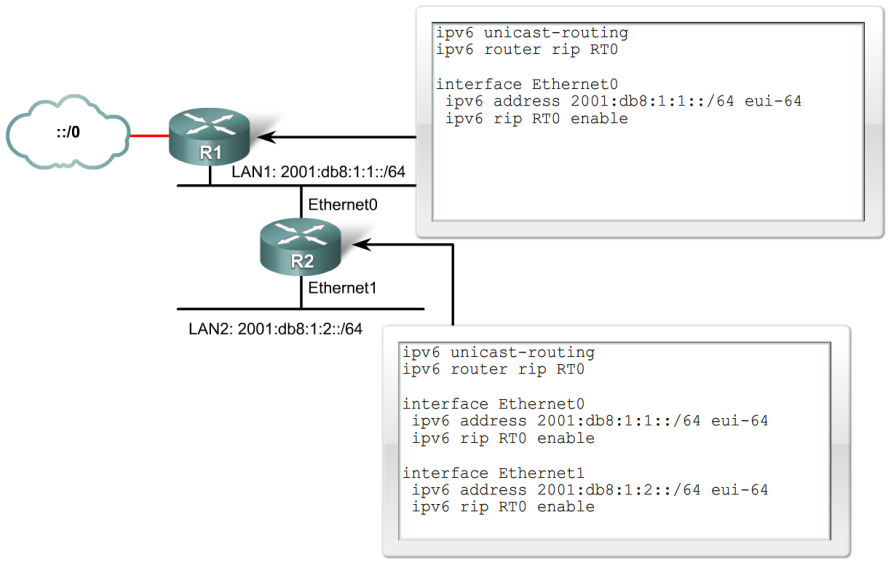
Configure New Generation RIP (RIPng) to use IPv6

- Explain how to configure and verify RIPng for IPv6

Configuring RIPng for IPv6

Command	Purpose
`RouterX(config)#ipv6 router rip name`	Creates and enters RIP router configuration mode.
`RouterX(config-if)#ipv6 rip name enable`	Configures RIP on an interface.

RIPng for IPv6 Configuration



Configure New Generation RIP (RIPng) to use IPv6

- Explain how to verify and troubleshoot IPv6

Commands

Command	Purpose
`show ipv6 interface`	Displays the status of interfaces configured for IPv6.
`show ipv6 interface brief`	Displays a summarized status of interfaces configured for IPv6.
`show ipv6 neighbors`	Displays IPv6 neighbor discovery cache information.
`show ipv6 protocols`	Displays the parameters and current state of the active IPv6 routing protocol processes.
`show ipv6 rip`	Displays information about the current
`show ipv6 route`	Displays the current IPv6 routing table.
`show ipv6 route summary`	Displays a summarized form of the current IPv6 routing table.
`show ipv6 routers`	Displays IPv6 router advertisement information received from other routers.
`show ipv6 static`	Displays only static IPv6 routes installed in the routing table.
`show ipv6 static 2001:db8:5555:0/16`	Displays only static route information about the specific address given.
`show ipv6 static interface serial 0/0`	Displays only static route information with the specified interface as the outgoing interface.
`show ipv6 static detail`	Displays a more detailed entry for IPv6 static routes.
`show ipv6 traffic`	Displays statistics about IPv6 traffic.

Summary

- Dynamic Host Control Protocol (DHCP)

  This is a means of assigning IP address and other configuration information automatically.

- DHCP operation
  - –3 different allocation methods
    - •Manual
    - •Automatic
    - •Dynamic
  - –Steps to configure DHCP
    - •Define range of addresses
    - •Create DHCP pool
    - •Configure DHCP pool specifics

Summary

- DHCP Relay

  Concept of using a router configured to listen for DHCP messages from DHCP clients and then forwards those messages to servers on different subnets

- Troubleshooting DHCP

  –Most problems arise due to configuration errors

  –Commands to aid troubleshooting

    •Show ip dhcp

    •Show run

    •debug

Summary

- Private IP addresses
  - –Class A = 10.x.x.x
  - –Class B = 172.16.x.x – 172.31.x.x
  - –Class C = 192.168.x.x
- Network Address Translation (NAT)
  - –A means of translating private IP addresses to public IP addresses
  - –Type s of NAT
    - •Static
    - •Dynamic
  - –Some commands used for troubleshooting
    - •Show ip nat translations
    - •Show ip nat statistics
    - •Debug ip nat

Summary

- IPv6
  - –A 128 bit address that uses colons to separate entries
  - –Normally written as 8 groups of 4 hexadecimal digits
- Cisco IOS Dual Stack
  - –A way of permitting a node to have connectivity to an IPv4 & IP v6 network simultaneously
- IPv6 Tunneling
  - –An IPV6 packet is encapsulated within another protocol

Summary

- Configuring RIPng with IPv6
  - 1st globally enable IPv6
  - 2nd enable IPv6 on interfaces on which IPv6 is to be enabled
  - 3rd enable RIPng using either
    - ipv6 rotuer rip *name*
    - ipv6 router *name* enable